

Table 2

PORTION	WEIGHT (KG)	TEMPERATURE (°C)	PROPERTIES
1	Totally 1850	900	small, loosely sintered lumps, 10-20 mm, of poor strength
2			
3	450	1300	Hard, molten lumps, must be crushed before use
4	Totally 670	1000-1100	Hard, sintered lumps having a size of 10-40 mm
5			

During calcination, the carbon content was decreased by carbon leaving as carbon dioxide. The carbon originates from calcium carbonate that accompanies the lime in the neutralisation process. The materials from portions no. 1 and 2 were agglomerated, but had a very poor strength and small size. The material from portion no. 3 was very much similar to natural fluorspar, in respect of strength and size.

During calcination in the bell-type furnace, it was noted that the carbon content was low even in this case. The material from portions no. 4 and 5 had very good strength properties, in practice equally good as the molten material from portion no. 3.

The materials from portions no. 1 and 2 were judged unsuitable for continued experiments, due to the risk of dusting and due to poor strength. The materials from portions no. 3, 4 and 5 had none or a very small ratio of fines fraction, and were judged suitable to be used in subsequent experiments. The composition of these materials is shown in the table below (% by weight):

Table 3

PORTION	Fe ₂ O ₃	Cr ₂ O ₃	NiO	MoO ₃	CaF ₂	CaSO ₄	C	Na ₂ O	CaO	SiO ₂	MgO
1	25.2	11.8	3.1	0.3	47.8	3.0	0.01	0.1	7.1	1.8	0.6
2	25.4	11.6	3.0	0.2	47.6	2.9	0.01	0.1	7.3	1.9	0.6
3	25.3	11.7	3.0	0.2	41.0	2.8	0.01	0.1	14*)	2.0	0.5
4	27.9	6.1	3.4	0.3	51.5	0.4	0.02	0	10.5	1.9	0.4
5	27.6	5.9	3.5	0.2	51.2	0.4	0.02	0	10.8	2.1	0.4

*) Given as residual content up to 100 %

During the experiments, no measurements were made in respect of occurrence of HF or SO₂, both of which are irritating already at low contents. The table shows however, concerning portion no. 3, that CaF₂ is partially lost at temperatures close to 1300 °C. No loss of CaF₂ has been noted concerning portions no. 1, 2, 4 and 5.

Natural fluorspar normally used in the melting shop, has the following approximate composition (% by weight):

In addition to the above described process steps, a continuous measurement of gas flows to the AOD-converter (O_2 , N_2), exhaust gas flows from the AOD-converter (CO , CO_2 , O_2), and material weight to different hoppers, took place. In order to investigate whether the use of hydroflux generates additional Cr^{6+} , the content of Cr^{6+} was analysed in the water pool of a venturi scrubber in an exhaust emission control plant, see Fig. 2. The content was analysed after the respective experimental heats. The arrows indicate the reference heats with addition solely of natural fluorspar. From these measurements it is clear that the use of hydroflux does not give rise to increased Cr^{6+} formation, compared to the use of natural fluorspar, which is seen in Fig. 2.

The slag samples from the 9 experimental heats were analysed and their compositions are given in the table below.

Table 6 Composition of slag samples from the 9 experimental heats

	AOD 1	AOD 2	AOD 3	AOD 4	AOD 5	AOD 6	AOD 7	AOD 8	AOD 9
Cr_2O_3	5.0	3.6	1.1	1.0	0.2	0.2	0.3	0.4	0.1
FeO	0.4	0.6	1.3	0.3	0.2	0.3	0.4	0.6	0.3
MgO	3.7	4.3	7.4	10.6	9.1	8.6	10.3	10.2	10.1
SiO_2	32.7	31.6	32.6	30.4	30.4	29.6	29.6	31.5	30.4
CaO	54.7	57.6	56.2	56.4	62.7	62.9	60.2	57.5	61.8
F	4.6	4.4	4.2	4.5	3.9	5.0	4.1	3.6	3.5
CaF_2	9.5	9.0	8.6	9.2	8.0	10.2	8.4	7.4	7.2
CaO calc	47.9	51.1	50.2	49.8	56.9	55.5	54.2	52.2	56.6
MnO	1.2	0.9	0.4	0.4	0.1	0.1	0.1	0.2	0.1
Al_2O_3	0.7	0.9	1.4	2.4	1.6	1.6	2.7	2.5	1.9
$CaSO_4$	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	2.7	<0.3	2.7
Basicitet	1.5	1.6	1.5	1.6	1.8	1.9	1.8	1.7	1.9

It is clear from the table that a few introductory experimental heats were required to find the optimum conditions for reduction of the chromium oxide. During these introductory experimental heats, the required amount of extra $FeSi$ was found. Experimental heats no. 7 and 9 were produced with sulphuric containing hydroflux, and in these cases a small increase of the sulphur content in the slag could be noted. An analysis of the sulphur content of the steel indicates that sulphur is not re-introduced into the heat, and therefore one may assume that a small part of the sulphur ends up in the slag and the main part leaves with the exhaust gases as SO_2 .

Experience from the conducted pilot experiments surprisingly shows that the hydroflux is also suitable for use as a fluxing agent in connection with carbon steel production. In connection with carbon steel production, the use of fluorspar has, as is well known,